

TRYPANOSOMIASIS OF DOMESTIC ANIMALS IN NORTHERN NIGERIA

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PLATES I—III

Trypanosomiasis is very prevalent amongst domestic animals in Northern Nigeria, and, at any rate in the south-western portions of the Protectorate, accounts not only for a heavy mortality, but also for serious financial losses, due to sickness, forced sales and the slaughtering of stock in unsuitable markets. It is difficult to give any adequate idea of the grave nature of the losses, but some conception of their extent may be gathered from the two following instances:—During the greater part of 1912 I was stationed in Ilorin, a province which, with the exception of one division, is considered not unsuitable for horses. Nevertheless, during the eight completed months of my residence, ten out of the fifteen horses in the possession of Europeans contracted trypanosomiasis, and six died of the disease. An experiment was also made with a view to introducing animal transport into the province. Ten healthy donkeys were selected for this purpose, and sent to carry loads from Ilorin town to Agugi, a village some thirty miles to the east. Within three months all had died of trypanosomiasis. At Zungeru, during the year 1911, twenty-five horses were treated for this disease in the isolation camp, and of these 40% either died or were so seriously affected that their owners thought it wise to part with them at the small price a native is always willing to pay for a sick animal. At Lokoja the disease is even more serious, and Dr. C. F. Watson has estimated that among the horses treated for tsetse disease there, the rate of dead and incapacitated horses is over 73%. There can, moreover, be little doubt that the disease is spreading; a fact proved by the additions made from time to time to the list of localities in which the Government declines to compensate officers for the loss of horses which have died from trypanosomiasis contracted in the discharge of official duties.

Difficult as it is to estimate the losses among horses belonging to the small number of Europeans stationed in the Protectorate, it is altogether impossible to ascertain those of the natives. They must, however, be very great, and their magnitude may be gauged by the experiences of the Emirs who attended the Coronation Durbar at Zaria in June, 1911, one of whom is said to have lost 70 per cent. of his horses. Before the British undertook the administration of Nigeria, certain tracts of country known to be unsuitable for horses were sedulously avoided. Europeans, however, are compelled to penetrate these districts in the discharge of their duties, and are followed by the native officials, not only at the sacrifice of their own animals, but also greatly to the detriment of the whole country, since the infected horses returning home, or passing through other districts, spread the disease in every direction.

Besides horses, the cattle, sheep, goats and dogs are also affected. In their long trek to the coast, the herds of cattle from the north carry trypanosomiasis with them, maintaining the infection in old localities and introducing it into new. The herdsmen are quick to detect the symptoms of the disease, and, if they appear in one of their animals, are accustomed to slaughter the beast wherever they may happen to be. The fate of those that sicken is to be butchered by the roadside, and it is a common sight to see a carcass cut up and laid out for sale far away from any native town. Ilorin is situated at a point on the main caravan road where the routes from Kano and Sokoto converge, and the majority of the animals slaughtered there for the market were found on examination to be suffering from trypanosomiasis.

In Table I the results of the examinations of thirty-five of these animals is shown:—

TABLE I.—Trypanosomes found in the blood of thirty-five sick animals being slaughtered for the Ilorin market

Host	<i>T. brucei</i>	<i>T. vivax</i>	<i>T. nanum</i> or <i>pecorum</i>	Double infection
Cattle—Fulani breed	1	18	1	1
Sheep and rams	1	8	1	...
Goats ... ..	...	4	...	...
Totals	2	30	2	1

In November, 1911, Sir David Bruce published in No. 31 of the *Sleeping Sickness Bulletin*¹ a list of identifications of fifteen cases collected by me in Northern Nigeria of trypanosomiasis in horses. Since then I have added to these a number of fresh cases, both in horses and other domestic animals, bringing the number up to eighty-eight. An analysis of eighty-six of these cases, in which the infection was natural, is given below (Table II).

TABLE II.—Showing the infecting agent in eighty-six cases of naturally acquired trypanosomiasis in domestic animals in Northern Nigeria

Host	<i>T. brucei</i>	<i>T. vivax</i>	<i>T. nanum</i> or <i>pecorum</i>	<i>T. theileri</i>	Double infections
Horse	14	18	8	...	3
Donkey	2	2	...	...	...
Cattle—					1
Fulani breed	1	18	1	...	...
Dwarf breed ... ..	...	2	...	1	...
Sheep and ram	1	8	1	...	...
Goat ... ..	...	4	...	...	...
Dog ... ..	...	1	...	...	...
Totals	18	53	10	1	4

As it was impossible in Northern Nigeria to carry out systematic series of experiments on animals or to attempt cross immunity tests, the morphological characters of the trypanosomes found in blood-films had to be relied on for identification. By this means it was, of course, impossible to distinguish between the more closely allied species. *T. theileri* was observed once, but with this exception the trypanosomes detected fell naturally into three main groups, and, as individuals of each type had previously been examined by Sir David Bruce, his identifications have been adopted.²

T. brucei.* In twenty cases of natural infection trypanosomes were found which closely corresponded with the type described and figured by Sir David Bruce as *T. brucei*.³ In four cases (three horses and one donkey) posterior nuclear forms were detected, and

* This trypanosome is probably that for which Prof. Stephens and Dr. Blacklock have recently proposed the name *T. ugandae*. (Proc. Roy. Soc., B, Vol. LXXXVI, pp. 187-191).

in guinea-pigs and rats inoculated from three of these cases they appeared at certain stages of the disease in relatively large numbers. Posterior nuclear forms have been described in *T. equiperdum*, *T. pecaui* and *T. brucei*, as well as in *T. rhodesiense*. Their occurrence in these cases of trypanosomiasis in Nigeria does not therefore assist in precise identification. Sleeping sickness, however, is either altogether absent or quite uncommon at Zungeru and Ilorin, where the majority of my cases were found. In a number of films the long forms of the parasite were observed to have their posterior extremities peculiarly blunt and almost rectangular. No attempt was made to plot a curve to represent the variation in size of this trypanosome. Great variations were observed from day to day in the relative percentages of short and long forms, as is indicated in the tables given below, where the different forms were enumerated in the case of a horse, and in those of a rat and a guinea-pig inoculated with his blood. (See table on page 5.)

The disease set up by these trypanosomes appears to be extremely fatal. Of the eleven horses and two donkeys suffering from this form of trypanosomiasis of which I have complete records none recovered. In horses the disease seems to occur in two forms, some cases end fatally in two to four weeks, others linger on for as many months. All the cases in which posterior nuclear forms were observed were of the acute type, death occurring within a month of the onset of the disease.

The general symptoms in horses were fever, emaciation, and more or less pronounced oedema of the legs, belly and scrotum. The appetite was irregular, but was often ravenous almost up to the hour of death. In the later stages restlessness was a distressing feature. Inflammation of the eyes was observed in two cases out of fourteen, and a greenish discharge from the nose, coughing up of mucus, and a herpetiform eruption on the upper lip occurred each in one case. The animals presented a dejected appearance in the early stages of the disease, their heads drooped, they dragged their hind legs in walking, moved slowly and with difficulty and were apt to stumble. They were notably insensitive to pain, as for instance, to the prick on the ear necessary to obtain blood for examination. Finally they became so weak and wasted that they could not rise.

Natural infections with trypanosomes of this type were found in the horse, donkey, Fulani cattle, and sheep. The parasite was also successfully transmitted by inoculation to a cow of the dwarf breed found in pagan districts of Nigeria. (See page 10.)

Date, 1912	HORSE (No. 35)		RAT		GUINEA-PIG	
	Forms with long, free flagella	Stumpy and intermediate forms	Forms with long, free flagella	Stumpy and intermediate forms	Forms with long, free flagella	Stumpy and intermediate forms
July 8 ...	24 %	76 %	...	...	...	...
" 9 ...	42 %	58 %	...	...	...	...
" 10 ...	...	...	Rat injected from horse. (Trypanosomes first appeared in the blood on July 16)		Guinea-pig injected from horse. (Trypanosomes first appeared in the blood on July 18)	
" 13 ...	29 %	71 %	...	...	...	...
" 16 ...	Trypanosomes very scanty		89 %	11 %	...	...
" 17 ...	...	...	98 %	2 %	...	...
" 18 ...	...	...	52 %	48 %	15 %	85 %
" 19 ...	...	...	15 %	85 %	40 %	60 %
" 20 ...	74 %	26 %	10 %	90 %	56 %	44 %
" 21 ...	...	...	8 %	92 %	16.5 %	83.5 %
" 27 ...	6 %	94 %	88 %	12 %	Died July 21	
" 28 ...	Died		...	...
" 29 ...			...	...
" 30 ...			58 %	42 %		
Aug. 1 ...			85 %	15 %		
" 4 ...			69 %	31 %		
" 5 ...			Died			

T. vivax. By far the most common form of trypanosome in my series of cases was one presenting the morphological features of *T. vivax*. It occurred in fifty-six of my eighty-six cases, and in fifty-three cases was the only trypanosome present, being but once associated with *T. brucei* and twice with *T. nanum* or *pecorum*.

This parasite was found in the following hosts:—Horse, donkey, Fulani cattle, dwarf cattle of Nigeria, sheep, goat and dog. From the fact that it was found in the dog, it is probable that this trypanosome is the parasite to which Ziemann⁴ gave the name *T. vivax*, and not the allied *T. cazalboui* described by Pecaud as occurring in Dahomey in horses. For Laveran and Mesnil say: 'Le fait que *Tr. Cazalboui* ne peut être inoculé ni au singe, ni au chien, ni aux petits rongeurs, permet de distinguer facilement ce trypan. des espèces qui s'en rapprochent au point de vue morphologique, mais qui sont pathogènes pour ces animaux.'⁵

In horses the disease set up by this parasite seems to be mild in Northern Nigeria. Of the fifteen cases of which I have complete records only one died, whereas fourteen recovered. The general symptoms were fever, emaciation and oedema of the legs, belly and scrotum, sometimes well marked, at other times scarcely perceptible. The animals presented a dejected appearance, moved awkwardly and reluctantly, and appeared as though tired. In severe cases they were somewhat insensitive to pain. The appetite was always good. In one case cough was a symptom, and in another nasal catarrh. No affections of the eyes were observed. Three cases were met with in donkeys, and of these two died and one recovered. The case of one of those that died was, however, complicated by a concurrent infection with *T. brucei*. Eighteen cases were found amongst Fulani cattle. Most of them were animals trekking down towards Lagos from Kano or Sokoto which had sickened on the road, and were therefore about to be butchered for the Ilorin market. Their native owners believed them to be dying, and were therefore having them slaughtered so as to anticipate death; but, beyond this assertion, I have no data from which to gauge the mortality from the disease in this breed of cattle. Both the dwarf cattle which came under my notice suffering from *T. vivax*, however, recovered. Similarly the eight sheep and rams I studied were animals about to be slaughtered so as to anticipate death, and the same remark applies to the four goats. The one dog in which *T. vivax* was found died.

T. nanum or *pecorum*. In a few cases small trypanosomes 9-12 μ in length without free flagella were found in blood-films, and these have been identified as *T. nanum* or *pecorum*. 'It will be

remembered the name *T. pecorum* was introduced by Bruce to cover the group of trypanosomes of which the *T. dimorphon* of Laveran and Mesnil and *T. congolense* are members, and that *nanum* is only distinguishable from *pecorum* by animal experiments.¹⁶

Trypanosomes of this type were met with in thirteen cases, in ten alone and in three associated with *T. vivax* or *T. brucei*. Ten of these cases were horses, two Fulani cows, and one a ram. Of the ten cases in horses one had a concurrent infection with *T. vivax* and another with *T. brucei*, leaving eight uncomplicated cases, of which one died, three recovered, and the remaining four had unknown issues.

The number of cases of this variety of trypanosomiasis that came under my notice does not, therefore, enable me to give any general account of the symptoms of the disease in Northern Nigeria. It may, however, be noted that oedema was present only to a slight extent in the cases seen, although lachrymal and nasal discharges were relatively more frequent than in infections with either *T. vivax* or *T. brucei*.

T. theileri. *T. theileri* was observed once in a cow of the dwarf breed found in Nigeria. The animal was feverish for a few days and wasted considerably, but soon recovered from the infection.

The period when trypanosomiasis is most common is undoubtedly the rainy season, which corresponds to the time during which the tsetse flies, which in the dry season retire to the banks of the streams and rivers, are most widely distributed over the country. The accompanying chart of the rainfall and the number of admissions of horses to the isolation camp at Zungeru for the year 1911 illustrates this point, although the number of cases dealt with is too small to form a reliable index. A better proof is afforded by the fact that the natives congratulate themselves at the end of the rainy season that those of their horses which have withstood the disease so far will be safe until the rains recommence. The dry season is also the time of year selected by the herdsmen of the north to undertake their long trek south with their cattle and sheep.

The province of Ilorin in Northern Nigeria is peculiar, inasmuch as, whilst *G. palpalis* and *G. tachinoides* are distributed all over it, tsetse flies of the *morsitans* group—*G. submorsitans* and *G. longipalpis*—are restricted to one, the Patigi or eastern, division. In

my series of cases of trypanosomiasis collected at Ilorin, twenty-four were animals that had never been into the Patigi division, and of these fourteen were infected with *T. vivax*, six with *T. brucei* and four with *T. nanum* or *pecorum*. The Patigi division is shunned by all herdsmen, and it is generally recognised that horses can neither live there nor be taken into the district without contracting tsetse disease. Two horses that had lived for years in Ilorin town were taken to Patigi during my last tour of service.

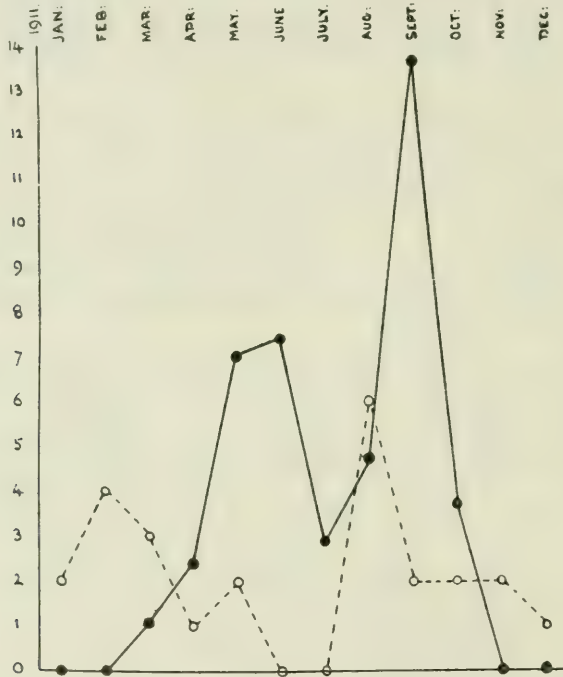


Chart showing the rainfall in inches (continuous line) and the number of cases of trypanosomiasis of horses admitted to the isolation camp (dotted line) at Zungeru during 1911.

Both returned infected with *T. brucei*, and both died shortly afterwards. In this connexion it should be mentioned that Bruce concludes that, in Uganda, 'The carrier of *Trypanosoma vivax* is probably *Glossina palpalis*,' and that *G. morsitans* is known to transmit *T. brucei*. It is possible that in the native towns and European stations flies of the genus *Stomoxys*, which abound in these places, may play a part in the transmission of trypanosomiasis. The horse (No. 42), for instance, had not been within

two miles of any spot known to be haunted by tsetse flies for five weeks previous to the onset of his symptoms, and it is practically certain that during this period he could not have been bitten by tsetse flies. He was, however, tormented by *Stomoxys* flies, which were exceedingly common at the time. Both *S. nigra* and *S. calcitrans* have been taken at Ilorin.

Treatment. The treatment usually adopted in Northern Nigeria for all cases of trypanosomiasis in horses is the administration of arsenious acid and perchloride of mercury by the mouth. This is the routine treatment adopted at the isolation camps at Zungeru and Lokoja. The doses usually employed are nine grains of the arsenic and three ounces of a 1 in 1,000 solution of the perchloride of mercury daily, divided into three doses; but I have also tried much larger doses, administered for a few days at a time only, in the hope that the sudden shock of arsenic might eliminate the trypanosomes before they had time to react to the drug, and with a view to avoiding the cumulative action on the host that has certainly sometimes proved fatal. It is doubtful whether this treatment has any beneficial results. In my experience it has not saved a single animal infected with *T. brucei*, and it is impossible to judge of its action on *T. vivax*, as this form of trypanosomiasis is as a rule not fatal, the animals recovering even when untreated. At one time it was asserted that such treatment accounted for the cure of 50 % of the cases at Zungeru. This, however, was before it was known that half the trypanosomiasis there was due to *T. vivax*, and was capable of spontaneous cure. The higher mortality recorded at Lokoja is probably accounted for by the larger percentage of cases of trypanosomiasis due to *T. brucei* which occur at that station.

Intravenous injections of antimony have met with no greater success in trypanosomiasis due to *T. brucei*. Organic arsenical compounds have been used in only a few cases, the high cost of the injections and the technical difficulties of administration standing in the way of the general use of these preparations until it is certain, not only that a cure will result, but also that immunity against future attacks will be established.

Arsenic and mercury have been used as prophylactics also, but without success.

No immunity follows an attack of trypanosomiasis, reinfections with the same or a different species of trypanosome being met with. The dwarf cow (No. 48) in my series was infected successively with *T. theileri*, *T. vivax* and *T. brucei*, and finally died of the last form of trypanosomiasis. The donkey (No. 47), after recovering from an infection with *T. vivax*, was infected by injection with *T. brucei*, and succumbed to the disease.

Treatment of any sort is, however, applicable only to Government stock and horses in the possession of Europeans. The great majority of cases, occurring in animals which are the property of natives, cannot be brought under treatment. It might be possible, nevertheless, to limit the spread of the disease by the establishment of isolation camps, and much might be effected by systematic clearing along the roads. The main caravan routes especially should be cleared, and inducement offered to the natives to farm the land on either side of the roads.

Dwarf cattle. In certain districts in which the Fulani cattle do not live a few dwarf cattle are found, which, because they occur in pagan country, are often referred to as 'pagan cattle.' In Ilorin they are kept in all the districts occupying the south-eastern corner of the province, from Ofa Ora to Ejiba on the north, and extending west along the southern boundary as far as Oke Awra. Dr. Foy, who made some interesting observations and experiments on a bull of this breed, thus described his physical characters. 'The body frame,' he says, 'was thick-set and broad and comparatively long for its height, the legs thick and short, the neck thick and short, the head short, and the horns short.'⁸ The accompanying photograph of a bull and cow brought from Awtun will help to give an accurate idea of the appearance of these singular animals (Pl. III, fig. 5).

The most remarkable point about these dwarf cattle, which are bred for slaughter only and are not used for milking, is that they live in districts in which the Fulani cattle cannot exist. For this reason it has been conjectured that they have acquired a high degree of immunity to trypanosome infections. Dr. Foy, who, as already stated, experimented on a bull of this breed, concluded:—

'(1) That a certain breed of cattle found in pagan districts possess a high degree of natural immunity in that they may harbour the trypanosome in the blood and yet keep in good condition and

show no signs of the disease, nor do they die from the infection so long as their environments are favourable. These environments are a free life, with ample food, especially plenty of green grass. Confinement, poor feeding, and hard exercise, tend to make the disease manifest itself clinically.

'(2) That such domesticated cattle may act as a reservoir of infection since the blood may prove infective at such times when clinical symptoms manifest themselves, although the trypanosome may not be found on making a microscopical examination.

'(3) That the subcutaneous injection of 26 c.c. of serum obtained from the blood of one of these cattle when manifesting no clinical symptoms of the disease did not prove infective when inoculated into a calf, nor did it act as a prophylactic when the calf was exposed to natural infection subsequently.'

He adds, in another part of the same paper, 'all strains of trypanosomes used or met with in the work were of the *T. brucei* type.'

At Ilorin I was able to carry out only two experiments with these cattle, but as the subject requires careful investigation, and promises to provide results of practical importance, I should, perhaps, place them on record here. On May 11th, 1912, two of these dwarf cattle (a cow and a bull) arrived at Ilorin from Awtun. As they had treked up all the way by road, they arrived in rather poor condition, but seemed, on the whole, to have stood the unusual exertion wonderfully well. On May 13th I made a thorough examination of the blood of each without detecting any trypanosomes, and four days later injected a rat and a guinea-pig each with 1 c.c. of blood taken from the cow. Neither of these animals developed any symptoms of disease, and, although they were kept under close and constant observation for four weeks, trypanosomes were never seen in their blood. The subsequent history of the cattle is given below:—

DWARF BULL (No. 50)

May 11th, 1912.—Arrived at Ilorin.

May 13th, 1912.—Blood examination—negative.

August 30th, 1912.—Trypanosomes (*T. vivax*) in the blood. Bull looks well. Untreated.

September 15th, 1912.—Blood examination—negative. Bull, however, looks ill.

September 19th, 1912.—Bull died of anthrax. No trypanosomes found in the blood nor in smears made from the organs after death.

DWARF COW (No. 48)

May 11th, 1912.—Arrived at Ilorin.

May 13th, 1912.—Blood examination—negative.

May 17th, 1912.—Blood examination—negative. Subcutaneous injections of the cow's blood made into a rat and a guinea-pig.

Rat under observation twenty-eight days, but never showed trypanosomes.

Guinea-pig under observation twenty-eight days but never showed trypanosomes.

August 30th, 1912.—Cow feverish and emaciated, no oedemas. Trypanosomes (*T. theileri* and *T. vivax*) present in the blood. Untreated.

September 7th, 1912.—Trypanosomes still present in the blood. Subcutaneous injection of two c.c. of the cow's blood into a guinea-pig.

Guinea-pig under observation nineteen days. Accidentally killed. Never showed trypanosomes.

September 18th, 1912.—Blood examination—negative. One c.c. of the cow's blood injected subcutaneously into a rat.

Rat under observation twenty-two days but never showed trypanosomes.

September 27th, 1912.—Cow looks well, and her blood has been free from trypanosomes since September 15th. Two c.c. of blood from donkey (No. 45), heavily infected with *T. brucei*, injected into cow subcutaneously.

October 8th, 1912.—Trypanosomes numerous (*T. brucei*). The blood was negative up to October 5th.

November 3rd, 1912.—Cow died. Trypanosomes still present in the blood but scanty.

Both animals developed a natural infection with *T. vivax*, and apparently recovered, for they ceased to show trypanosomes in films made from the peripheral blood. The cow in addition had a concurrent infection with *T. theileri*. The cow was then successfully infected by injection of blood from a donkey heavily infected with *T. brucei*, and, although the parasites soon became scarce in her blood, she died five weeks after the injection still showing a few trypanosomes in the peripheral blood.

It would be rash to draw definite conclusions from such experiments, but so far as they go they do tend to show that this breed of cattle, like horses, possesses an immunity to *T. vivax*, inasmuch as although these parasites may appear in their blood they do not produce a rapidly fatal disease. The immunity does not appear, however, to extend to *T. brucei*. The question then arises how do these cattle live in districts where the Fulani herdsmen dare not take their cattle to graze? The dwarf cattle are generally to be found in the immediate vicinity of villages, and unlike the Fulani cattle do not wander widely over the country in search of pastures. It was thought possible, therefore, that they might thus escape the attacks of *G. submorsitans*, the species of tsetse fly whose distribu-

tion (as already pointed out) is coextensive with the areas habitually shunned by the Fulani herdsmen. In consequence, collections of flies were obtained at Odo Okeri, Eri, Oro and Oke Onio, from spots where the cattle were actually grazing. In none of these collections was *G. submorsitans* present, although both *G. palpalis* and *G. tachinoides* were taken. I have to thank Mr. T. A. G. Budgen for very kindly superintending the work of a collector who was sent with him for this purpose. I can only hope that at some future date, and under more favourable conditions, it may be possible to make a thorough investigation of this interesting subject.

In conclusion, I would like to express my thanks to Mr. E. C. Duff for affording me an opportunity of examining the dwarf breed of cattle; to Dr. C. F. Watson and Dr. W. Morrison for very kindly sending me blood-films from Lokoja; to Dr. G. R. Twomey, who relieved me at Ilorin, for following the last stages of my experiments; and to Serjt. Moore for the careful record kept by him of the cases of trypanosomiasis occurring at Zungeru.

A tabular synopsis of the cases of trypanosomiasis in domestic animals, collected in Northern Nigeria, is appended.

SYNOPSIS OF CASES OF TRYPANOSOMIASIS OF DOMESTIC ANIMALS

COLLECTED IN NORTHERN NIGERIA

No.	Place	Host	Date	Identification	Result	Remarks
1	Minna	Horse	Aug., 1910	<i>T. vivax</i> *	Recovered	Mild case, no oedema.
2	Bida	"	Sept., 1910	<i>T. namum</i> or <i>peccatum</i> *	"	"
3	Zunguru	"	Nov., 1911	<i>T. vivax</i> *	"	"
4	"	"	"	<i>T. vivax</i> *	(?)	Died of intercurrent disease.
5	"	"	Jan., 1911	<i>T. brucei</i> *	Died	Ill 3 months. Latterly extremely emaciated, refusing food and water, unable to rest and constantly walking round and round in a small circle with the head bent almost down to the ground.
6	Benue R. near Umahla	"	Dec., 1910	<i>T. brucei</i> *	(?)	"
7	Ankpa	"	Jan., 1911	<i>T. vivax</i> *	(?)	A severe case. A large swelling formed under the throat, burst in a few days, and discharged large quantities of watery fluid.
8	Zunguru	"	"	<i>T. vivax</i> *	Recovered	"
9	"	"	"	<i>T. brucei</i> *	Died	Ill 7 weeks.
10	"	"	Feb., 1911	<i>T. vivax</i> *	Recovered	"
11	"	"	"	<i>T. vivax</i> *	"	"
12	"	"	Mar., 1911	<i>T. brucei</i> *	Died	Also microfilariae. Ill 5 months.
13	"	"	May, 1911	<i>T. vivax</i> *	Recovered	"
14	"	"	"	<i>T. vivax</i> *	"	"
15	"	"	"	<i>T. vivax</i> *	"	"

* Identifications by Sir David Bruce.

No.	Place	Host	Date	Identification	Result	Remarks
16	Lokoja	Horse	Oct., 1911	<i>T. brucei</i> †	Died	Had recovered from a previous attack of trypanosomiasis.
17	"	"	"	<i>T. vivax</i> †	Recovered	
18	"	"	"	<i>T. brucei</i> †	Died	' Ill for months.'
19	"	"	Nov., 1911	<i>T. brucei</i> †	(?)	' Ill for months.'
20	"	"	"	<i>T. vivax</i> †	Recovered	
21	"	"	"	<i>T. nanum</i> or <i>pecorum</i>	(?)	Sold to a native.
22	"	"	Mar., 1912	<i>T. nanum</i> or <i>pecorum</i>	Died	
23	"	"	Feb., 1912	<i>T. vivax</i>	"	' Very marked oedema of joints, legs, abdomen and testicles.'
24	Zungeru	"	Nov., 1911	<i>T. brucei</i>	"	
25	"	"	Dec., 1911	<i>T. vivax</i>	Recovered	
26	"	"	Jan., 1912	<i>T. vivax</i>	(?)	
27	"	"	"	<i>T. nanum</i> or <i>pecorum</i>	Recovered	But see No. 33. Lachrymal and nasal discharges. Guinea-pig injected with negative result.
28	"	"	"	<i>T. nanum</i> or <i>pecorum</i>	(?)	Sold to a native.
29	"	"	"	<i>T. nanum</i> or <i>pecorum</i>	(?)	
30	"	"	Feb., 1912	<i>T. brucei</i>	(?)	

† Identifications by Dr. Blacklock, The Runcom Research Laboratory.

SYNOPSIS OF CASES OF TRYPANOSOMIASIS OF DOMESTIC ANIMALS. COLLECTED IN NORTHERN NIGERIA. —continued.

No.	Place	Host	Date	Identification	Result	Remarks
31	Zungeru	Horse	Feb., 1912	<i>T. nanum</i> or <i>pecorum</i>	(?)	
32	Ilorin	"	"	<i>T. vivax</i>	Recovered	Also microfilariae present.
33	"	"	April, 1912	<i>T. nanum</i> or <i>pecorum</i> and <i>T. vivax</i>	Died	Same horse as No. 27. Ill 19 days. Very marked oedema subsiding latterly leaving the pony a mere bag of bones. Profuse diarrhoea.
34	Ilorin	"	June, 1912	<i>T. vivax</i>	Recovered	Mild infection.
35	Offa	"	July, 1912	<i>T. brucei</i>	Died	Pl. I, fig. 1. Microfilariae also present. Ill 30 days. Posterior nuclear forms present; oedema slight. In rat incubation 6 days, death on 26th day after injection. In guinea-pig incubation 8 days, death on 11th day after injection.
36	Ilorin	"	Aug., 1912	<i>T. nanum</i> or <i>pecorum</i>	Recovered	Also microfilariae present.
37	Patigi	"	"	<i>T. brucei</i>	Died	Posterior nuclear forms present. Ill 11 days.
38	Ilorin	"	"	<i>T. brucei</i>	"	Microfilariae detected in pony's blood last April. Ill 22 days. Eye symptoms present.
39	"	"	"	<i>T. nanum</i> or <i>pecorum</i> and <i>T. brucei</i>	(?)	Still ill on October 10th. <i>T. brucei</i> very scanty. A very young pony.
40	"	"	"	<i>T. vivax</i>	Recovered	
41	"	"	Sept., 1912	<i>T. vivax</i> and <i>T. brucei</i>	Died	Ill about 2 months.

No.	Place	Host	Date	Identification	Result	Remarks
42	Ilorin	Horse	Oct., 1912	<i>T. brucei</i>	Died	Pl. I, fig. 2. Possibly infected directly by Stomoxys from donkey No. 45 or No. 47. Posterior nuclear forms present. Well marked oedema. Ill 2 weeks. In guinea-pig incubation 19-23 days, death 42nd day.
43	Patigi	"	"	<i>T. brucei</i>	"	Ill about 3 weeks.
44	Ilorin	Donkey	Aug., 1912	<i>T. brucei</i>	"	Pl. II, fig. 3. Posterior nuclear forms present. Slight oedema. Ill about 3 weeks. In rat incubation 10 days, still alive on 34th day. In guinea-pig incubation 10 days, died on 58th day.
45	"	"	Sept., 1912	<i>T. brucei</i>	"	Pl. II, fig. 4. Ill about 8 weeks.
46	"	"	"	<i>T. vivax</i>	"	
47	"	"	"	<i>T. vivax</i>	Recovered	
47A	"	"	Oct., 1912	<i>T. brucei</i>	Died	Injected from donkey No. 45. Died 24 days after injection. Little or no oedema.
48	"	Dwarf cow	Aug., 1912	<i>T. theileri</i>	Recovered	Pl. III, fig. 5.
49	"	"	Sept., 1912	<i>T. vivax</i>	"	
49A	"	"	Oct., 1912	<i>T. brucei</i>	Died	Injected from donkey No. 45. Died 37 days after injection.
50	"	Dwarf bull	Aug., 1912	<i>T. vivax</i>	Recovered	
51	"	Fulani cow	Sept., 1912	<i>T. nanum</i> or <i>pecorum</i>	Slaughtered	Traking South.
52	"	"	"	<i>T. vivax</i>	"	"
53	"	"	"	<i>T. vivax</i>	"	"
54	"	Fulani bull	"	<i>T. vivax</i>	"	"

No.	Place	Host	Date	Identification	Result	Remarks
55	Ilorin	Fulani cow	Sept., 1912	<i>T. vivax</i>	Slaughtered	Treking South from Kano.
56	"	Fulani bull	"	<i>T. vivax</i>	"	"
57	"	"	"	<i>T. vivax</i>	"	"
58	"	Fulani cow	"	<i>T. vivax</i>	"	"
59	"	Fulani bull	"	<i>T. vivax</i>	"	"
60	"	"	"	<i>T. vivax</i>	"	"
61	"	"	"	<i>T. vivax</i>	"	"
62	"	"	"	<i>T. vivax</i>	"	"
63	"	"	"	<i>T. vivax</i>	"	"
64	"	"	"	<i>T. vivax</i>	"	Treking South from Kano. Ill 10 days.
65	"	"	"	<i>T. vivax</i>	"	"
66	"	Fulani cow	"	<i>T. nanum</i> or <i>pecorum</i> and <i>T. vivax</i>	Sent to Ibadan to be slaughtered	Ilorin cow.
67	"	"	"	<i>T. vivax</i>	Slaughtered	Treking South from Kano.
68	"	"	Oct., 1912	<i>T. brucei</i>	"	" (Jebba route). Posterior nuclear forms present.
69	"	"	"	<i>T. vivax</i>	"	from Hadeija (Patigi route).
70	"	"	"	<i>T. vivax</i>	"	from Hausa country (Jebba route).
71	"	"	"	<i>T. vivax</i>	"	"

No.	Place	Host	Date	Identification	Result	Remarks
72	Ilorin	Sheep	Sept., 1912	<i>T. vivax</i>	Slaughtered	
73	"	Ram	"	<i>T. brucei</i>	"	Long forms 21 μ , stumpy 13-14 μ
74	"	"	"	<i>T. vivax</i>	"	Treking South from Kano.
75	"	"	"	<i>T. vivax</i>	"	" " from North
76	"	Sheep	"	<i>T. vivax</i>	"	" " from Kano.
77	"	Ram	"	<i>T. vivax</i>	"	" "
78	"	"	"	<i>T. vivax</i>	"	" "
79	"	"	"	<i>T. vivax</i>	"	" " Patigi route).
80	"	Sheep	Oct., 1912	<i>T. vivax</i>	"	From Alapa, Ilorin:
81	"	Ram	"	<i>T. nanum</i> or <i>pecorum</i>	"	Treking South from Kano (Jibba route).
82	"	Goat	Sept., 1912	<i>T. vivax</i>	"	
83	"	"	"	<i>T. vivax</i>	"	
84	"	"	Oct., 1912	<i>T. vivax</i>	"	Ilorin goat.
85	"	"	"	<i>T. vivax</i>	"	" "
86	"	Dog	Sept., 1912	<i>T. vivax</i>	Died	

SUMMARY

1. Trypanosomes presenting the morphological characters of *T. brucei*, *T. vivax*, *T. nanum* or *pecorum*, and *T. theileri* have been found in Northern Nigeria in the blood of domestic animals; *T. brucei* in the horse, donkey, Fulani cattle, dwarf cattle and sheep; *T. vivax* in the horse, donkey, Fulani cattle, dwarf cattle, sheep, goat and dog; *T. nanum* or *pecorum* in the horse, Fulani cattle and sheep; and *T. theileri* in the dwarf cattle.

2. *T. vivax* is the most common form at any rate in the south-western portions of the Protectorate, being present in fifty-five out of eighty-four cases collected in Ilorin province, the Niger province, and at Lokoja.

3. Of twenty Fulani cattle trekking down towards the coast from the provinces of the north, and found to be suffering from trypanosomiasis, eighteen harboured *T. vivax*.

4. In horses *T. vivax* produces a much less serious disease than *T. brucei*. Of fifteen cases infected with *T. vivax*, of which the records are complete, fourteen recovered. Of eleven cases infected with *T. brucei* none recovered.

5. The dwarf breed of cattle found in certain tsetse-haunted districts of Northern Nigeria, and credited with a natural immunity to trypanosomiasis, while apparently recovering from infections with *T. vivax*, succumb to *T. brucei*.

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EXPLANATION OF PLATE I

- Fig. 1. Horse (No. 35). Trypanosomiasis (*T. brucei*). Ilorin,
July, 1912.
- Fig. 2. Horse (No. 42). Trypanosomiasis (*T. brucei*). Ilorin,
October, 1912.

EXPLANATION OF PLATE II

Fig. 3. Donkey (No. 44). Trypanosomiasis (*T. brucei*). Ilorin,
August, 1912.

Fig. 4. Donkey (No. 45). Trypanosomiasis (*T. brucei*). Ilorin,
September, 1912.

EXPLANATION OF PLATE III

Fig. 5. Dwarf cattle. Ilorin, May, 1912.



FIG. 1

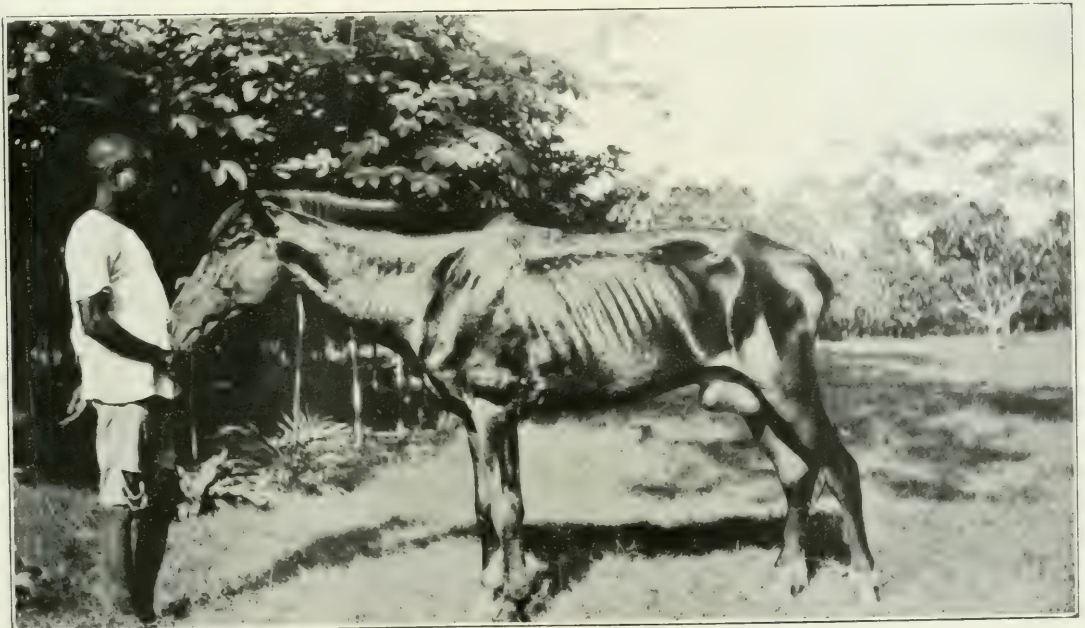


FIG. 2



FIG. 3

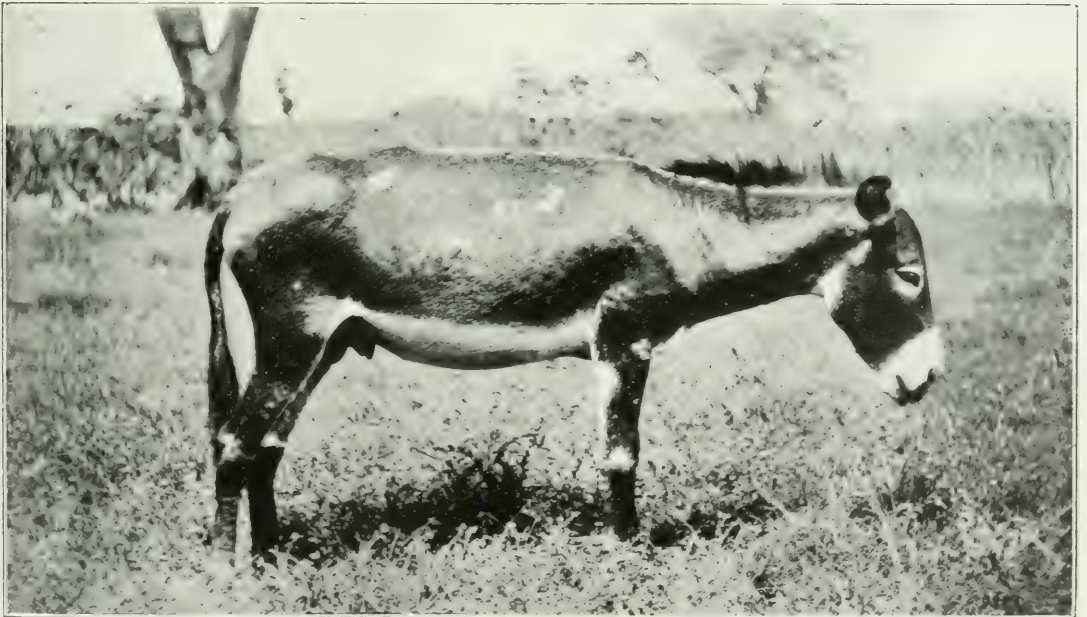


FIG. 4



FIG. 5